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ABSTRACT

In order to provide students with a semi-independent study/learning environment, a Learning Materials Center (LMC) was developed at Cerritos College (California). Of the four courses in the LMC program, Math-30 (elementary algebra) was chosen for study because it provided opportunities for follow-up studies. The purpose of this study was to evaluate the effects of the LMC approach upon Math-30 students, and to compare results with analagous data from traditional lecture Math-30 courses, which were randomly selected. Final course grades, operationally defined as measures of achievement, and course retention rates were used as measures of course effectiveness. Conclusions reached were: (1) analysis of the SCAT-Q Placement Test scores revealed no significant difference in mathematical aptitude between LMC and traditional Math-30 students; there is probably no difference in retention rates between LMC and traditional Math-30; and (3) of students withdrawing, 42.3% of those in LMC re-enrolled in a Math-30 course, compared with 21.2% of the traditional students who re-enrolled. (RN)

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AN EVALUATION OF A LEARNING MATERIALS CENTER APPROACH TO MATHEMATICS

Office of
Institutional Research
Cerritos College
May, 1972

JC 720 130

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UNIVERSITY OF CALIF.
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INTRODUCTION

The "Learning Materials Center" ("L.M.C.") Math-30 program was developed in an attempt to provide the students with a learning environment that would be more conducive to semi-independent study relative to traditional lecture approaches. The semi-independent mathematics program in the "L.M.C." includes Math 50-Basic Math; Math 30-Elementary Algebra; Math 23-Intermediate Algebra; and Math 21-Trigonometry. Math 30-Elementary Algebra was chosen for study because it is the beginning algebra course and would provide greater opportunity for follow-up studies.

At the request of the chairman of the Sciences, Engineering and Math division, the Office of Institutional Research was asked to conduct a study of the "L.M.C." approach to teaching Math-30. The general purpose of this investigation was to evaluate the effects the "L.M.C." approach to Math-30 instruction has had upon the students enrolled in the program. Final course grades, operationally defined as measures of achievement, and course retention-rates were selected as criterion variables in an attempt to provide objective measures of course effectiveness. Furthermore, in order to provide bench marks for comparison a decision was made to obtain analogous data from a random sampling of traditional "Lecture" ("L") Math-30 courses.

The specific objectives of the present study were to: (1) as measured by SCAT-Q placement test scores, compare "mathematical aptitude" between "L" and "L.M.C." Math-30 students; (2) compare retention rates between "L.M.C." and "L" Math-30 students as measured by the proportion of students who received a W (Withdrawal) or UW (Unofficial Withdrawal) grade; (3) as

indicated by the distribution of final grades, compare student "achievement" between "L.M.C." and "L" students; and (4) conduct a follow-up study as to academic status for those "L.M.C." and "L" students who received a grade of W or UW during the prior semester.

In order to carry out the aforementioned objectives of the study, placement test scores, grade reports, and current enrollment status records (Spring, 1972) were obtained for all students who had enrolled in a "L.M.C." Math-30 course in the Fall, 1971 (this amounted to 5 classes). For comparison, five "L" Math-30 classes were randomly selected and analogous records were obtained for each student enrolled.

Data Analyses and Results

Enrollment

In the Fall Semester, 1971, the five "L.M.C." Math-30 courses offered had a total enrollment of 188* students, which amountedto an average class size of 38. In comparison the five "L" Math-30 courses randomly sampled for the study had a total enrollment of 203* students or an average class size of 41.

Math Placement Test Data

In order to compare "mathematical aptitude" relative to students in the "L.M.C." and "L" Math-30 courses, SCAT-Q Placement Test scores (for those who had comparable placement test scores recorded) were obtained for all students enrolled in the Math-30 courses selected for study.

Pertaining to the "L.M.C." students, 44 of the 188 enrolled had recorded SCAT-Q scores, compared to 34 of the 203 "L" students.

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* Total does not include "No Shows".

Analysis of the test scores revealed that the average SCAT-Q raw score for the "L.M.C." students was 23.36 compared to a mean score of 23.58 for the "L" Math-30 students.

Retention:

Learning Materials Center Classes

Of the 188 students enrolled in the "L.M.C." Math-30 course for the Fall, 1971, 70 or 37.2% received a grade of W; 27 or 14% received a UW. Combining W and UW grades, 97 or 51.6% of the 188 received a "Withdrawal" grade.

Lecture Classes

Of the 203 students sampled who were enrolled in a "L" Math-30 course, 76 or 37.4% received a grade of W; 4 or 2% received a grade of UW. In summary, a total of 80 or 39.4% of the 203 students sampled received a "Withdrawal" grade. See Figure 1 for a graphic comparison of the "L.M.C." and "L" Math-30 courses sampled.

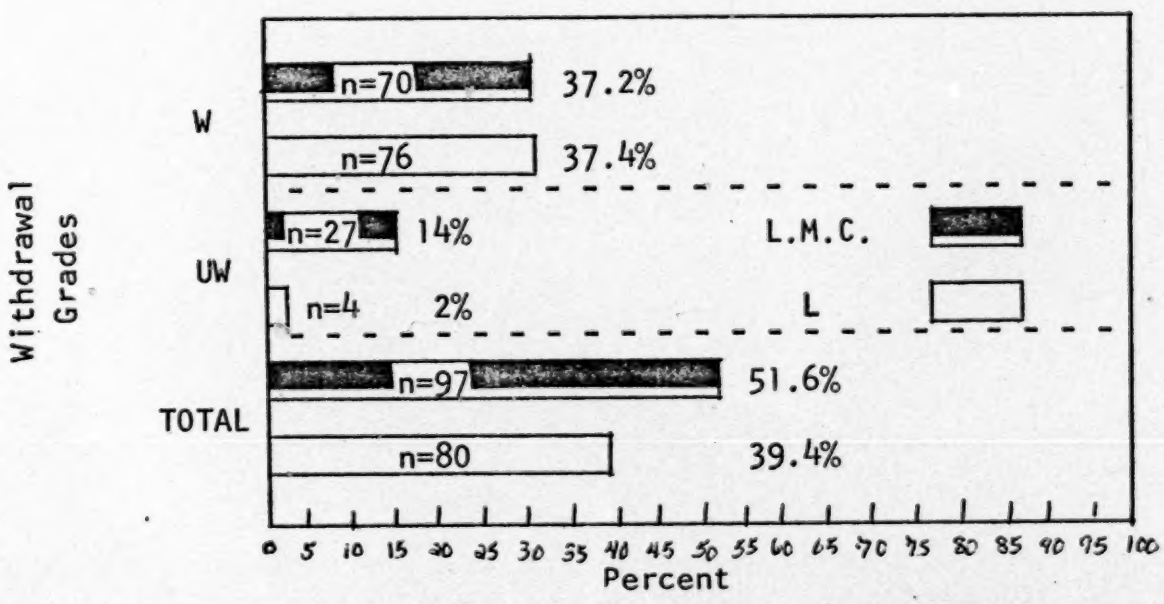

Fig. 1. Number and Percent of students who received "Withdrawal" grades: "L.M.C." and "L" Math-30 courses.

Grade Distribution: "Learning Materials Center" and "Lecture" Math-30 courses.

Comparing academic achievement (grades A through E) across "L.M.C." and "L" Math-30 courses, 37 or 19.7% of the 188 "L.M.C." students earned A's, compared to 24 or 11.8% of the 203 "L" students. Concerning the grade of B, it was earned by 22 or 11.7% of the "L.M.C." students, and by 24 or 11.8% of the "L" enrollees. Twenty-three (23) or 12.2% of the "L.M.C." students earned C's, compared to 54 or 26.6% of the "L" students. Pertaining to D grades, 4 or 2.1% of the "L.M.C." students earned D's compared to 19 or 9.4% of the "L" students. An F grade was earned by one student in each of the Math-30 courses. Four or 2.1% of the "L.M.C." students earned E's; one student earned a grade of E in an "L" course. See Figure 2.

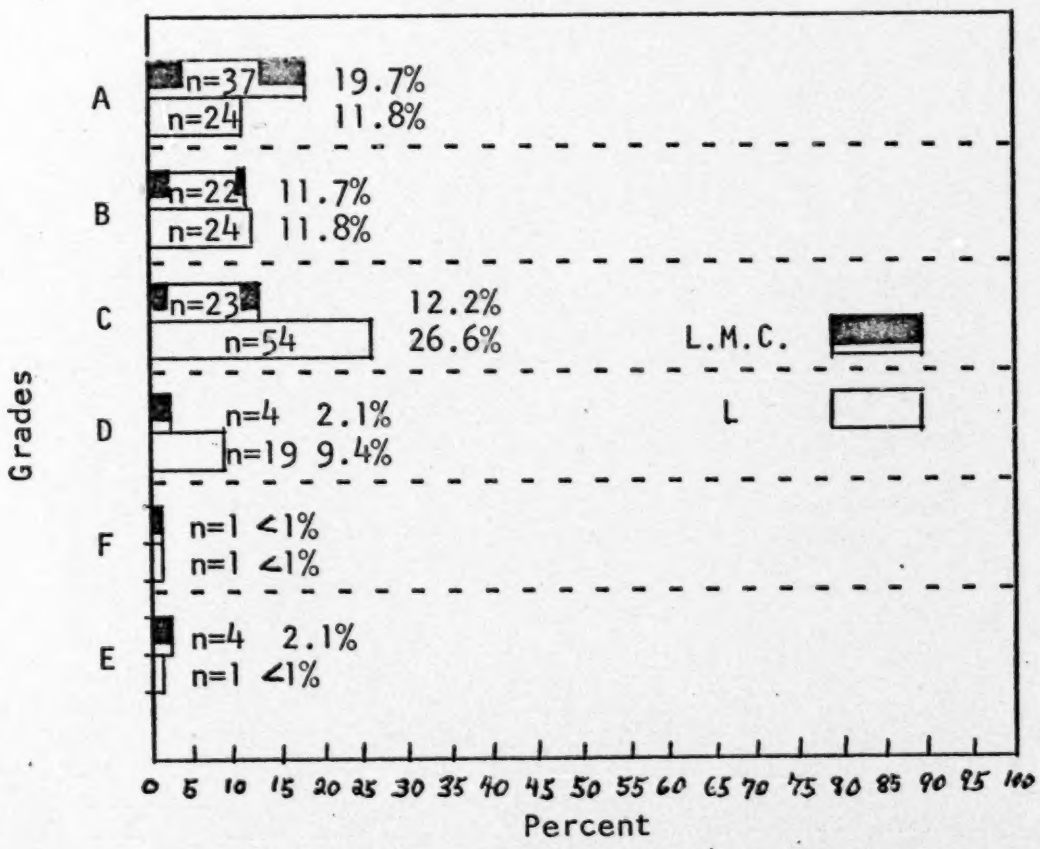

Fig. 2. Distribution of grades (A through E) for "Learning Materials Center" and "Lecture" Math-30 courses.

If one were to operationally define "successful" achievement as having earned a grade of A, B, or C and "unsuccessful" achievement as having earned a grade of D or F, then one observes that 82 or 43.6% of the 188 "L.M.C." students attained "successful" achievement and 5 or 2.6% "unsuccessful" achievement.

Applying the same analysis to the "L" students, one observes that 102 or 50.2% attained "successful" achievement and 20 or 9.8% "unsuccessful" achievement. See Figure 3 for a graphic comparison and Table 1 for a statistical comparison*.

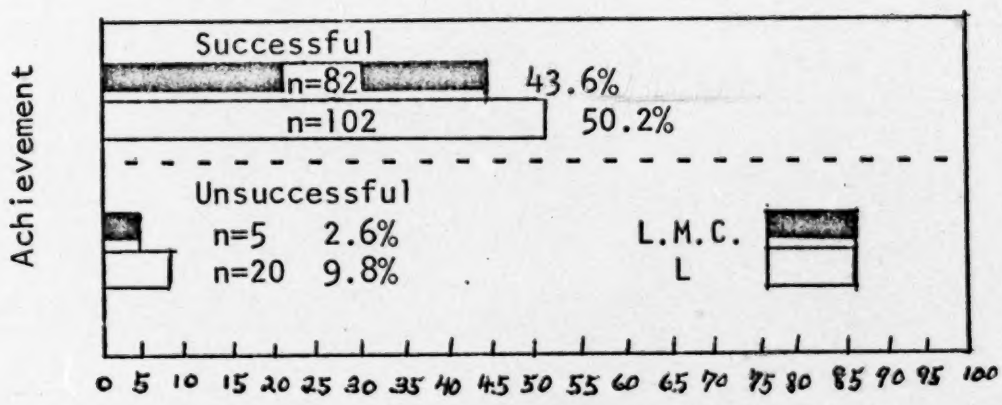

Fig. 3. Number and proportion of "L.M.C." and "L" Math-30 students who attained "successful" or "unsuccessful" achievement. (Proportions based on total enrollment excluding "No Shows".)

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* Fisher's Test of a difference between uncorrelated proportions was employed for all statistical tests (.05 level of confidence).

Table 1

Comparison of Final Subject Grades (A through F) Between "L.M.C." and "L" Math-30 Students as a Function of "Successful" Versus "Unsuccessful" Achievement. (Proportions based on total enrollment not including "No Shows".)

Final Grades	Group					
	"L.M.C."		"L"			
	No.	%	No.	%	Diff.	"t"
Successful Achievement	82	43.6%	102	50.2%	-6.6%	1.47*
Unsuccessful Achievement	5	2.6%	20	9.8%	-7.2%	2.88**
Totals	87	46.2%	122	60.0%		

* Not significant at the .05 level of confidence.
** Significant beyond the .05 level of confidence.

On the other hand, if the computation of "successful" and "unsuccessful" achievement is based on the total number of "L.M.C." or "L" students that earned a grade of A,B,C,D, or F, then one observes that 82 or 94.2% of the 87 "L.M.C." students attained "successful" achievement compared to 102 or 83.6% of the 122 "L" students. Thus a difference of 10.6% in "successful" achievement in favor of the "L.M.C." Math-30 students is realized if the proportions of grades are computed using as a divisor the total number of students who earned grades A through F. See Figure 4 for a graphic comparison and Table 2 for a statistical comparison.

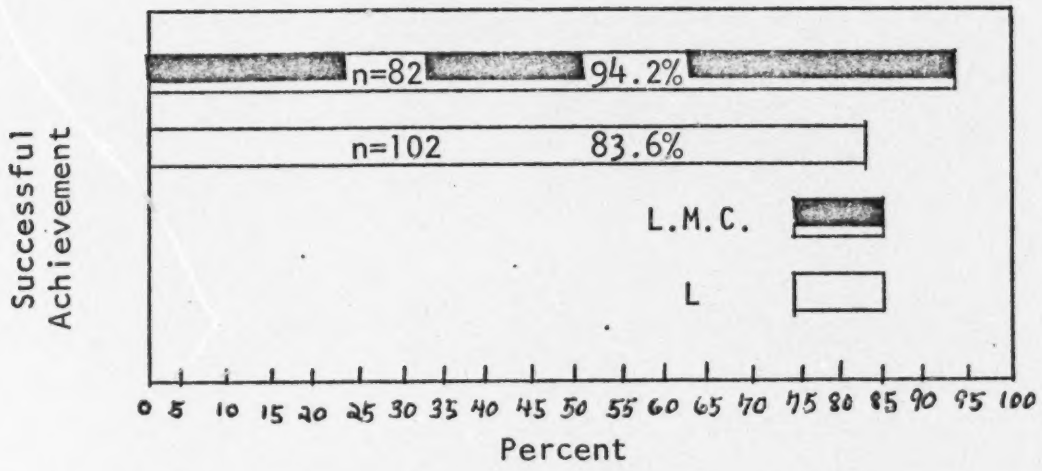

Fig. 4. Number and proportion of "L.M.C." and "L" Math-30 students who attained "successful" achievement. (Proportions based on total number of students who earned a grade of A through F.)

Table 2

Comparison of Final Subject Grades (A through F) Between "L.M.C." and "L" Math-30 Students as a Function of "Successful" Versus "Unsuccessful" Achievement. (Proportions based on total number of students that earned a grade A through F.)

Final Grades	Group					
	"L.M.C."		"L"			
	No.	%	No.	%	Diff.	"t"
Successful Achievement	82	94.2%	102	83.6%	10.6	2.41*
Unsuccessful Achievement	5	5.8%	20	16.4%	-10.6	2.41*
Totals	87	100.0%	122	100.0%		

* Significant beyond the .05 level of confidence.

Follow-Up Results: Math-30 "Learning Materials Center" and "Lecture" students who earned a "Withdrawal", grade.

Learning Materials Center Classes

Concerning the 70 students who earned a grade of W in a "L.M.C." math course (Fall, 1971): 18 or 25.7% re-enrolled in a "L.M.C." Math-30 course, 10 or 14.3% re-enrolled in a "L" Math-30 course, one or 1.4% enrolled in Math-15, 3 or 4.3% enrolled in Math-23 and, 2 or 2.8% were enrolled in a Math 50-course. Twenty-one (21) or 30.0% were not enrolled in a math course, and 15 or 21.4% were no longer attending Cerritos College.

Pertaining to the 27 students who received a grade of UW: 13 or 48.1% re-enrolled in a "L.M.C." Math-30 course, none re-enrolled in "L" Math-30 and, 2 or 7.4% were enrolled in a Math-23 course. Five (5) or 18.5% were not enrolled in a math course, and 7 or 25.9% were no longer attending Cerritos College. See Table 3.

Table 3

Follow-Up Results of those "L.M.C." Students Who Received a W or UW Grade: Frequencies and Proportions Across Categories of Enrollment.

W's				UW's			
Math 30 L.M.C.	= 18	=	25.7%	Math 30 L.M.C.	= 13	=	48.1%
Math 30 L	= 10	=	14.3%	Math 30 L	= 0	=	0.0%
Not math	= 21	=	30.0%	No math	= 5	=	18.5%
No attending Cerritos	= 15	=	21.4%	Not attending Cerritos	= 7	=	25.9%
Math 23	= 3	=	4.3%	Math 23	= 2	=	7.4%
Math 15	= 1	=	1.4%				
Math 50	= 2	=	2.8%				

Combining the data of the 97 students who had earned a grade of W or UW in a "L.M.C." math course (Fall, 1971): 31 or 32.0% re-enrolled in a "L.M.C." Math-30 course; 10 or 10.3% re-enrolled in a "L" Math-30 course; one or 1.0% enrolled in Math-15; 5 or 5.2% enrolled in Math-23; twenty-six (26) or 26.8% were not enrolled in a math course, and 22 or 22.7% were no longer attending Cerritos College. See Figure 5.

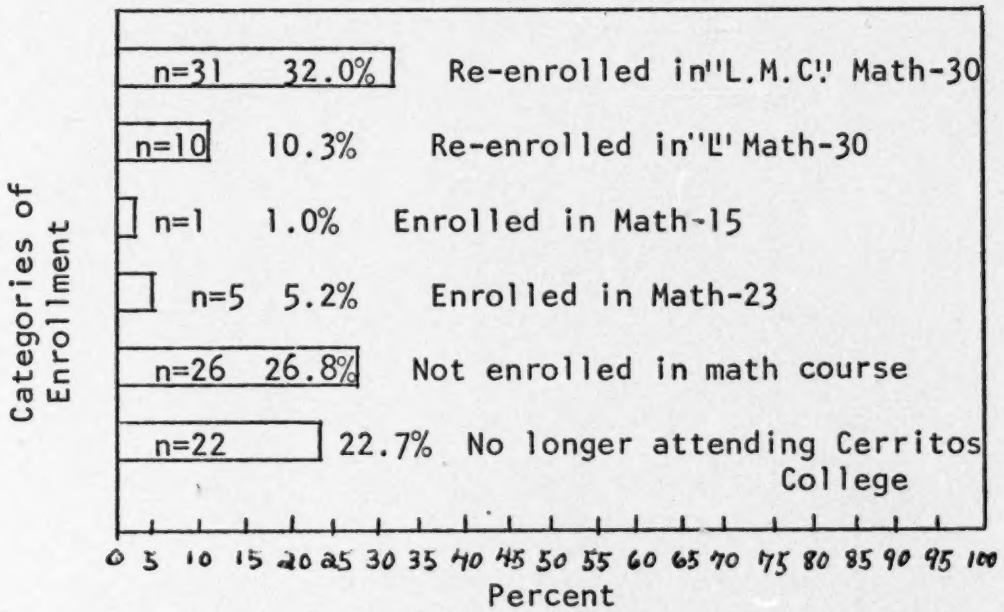
n=31 32.0% Re-enrolled in "L.M.C." Math-30
n=10 10.3% Re-enrolled in "L" Math-30
n=1 1.0% Enrolled in Math-15
n=5 5.2% Enrolled in Math-23
n=26 26.8% Not enrolled in math course
n=22 22.7% No longer attending Cerritos College
Categories of Enrollment
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent

Fig. 5. Follow-Up results of "L.M.C." students (W's and UW's combined): frequencies and proportions across categories of enrollment.

In summary, 41 or 42.3% of the 97 students had re-enrolled in a Math-30 course; 8 or 8.2% were enrolled in another math course; 26 or 26.8% were not enrolled in a math course and; 22 or 22.7% were no longer attending Cerritos College. See Figure 6.

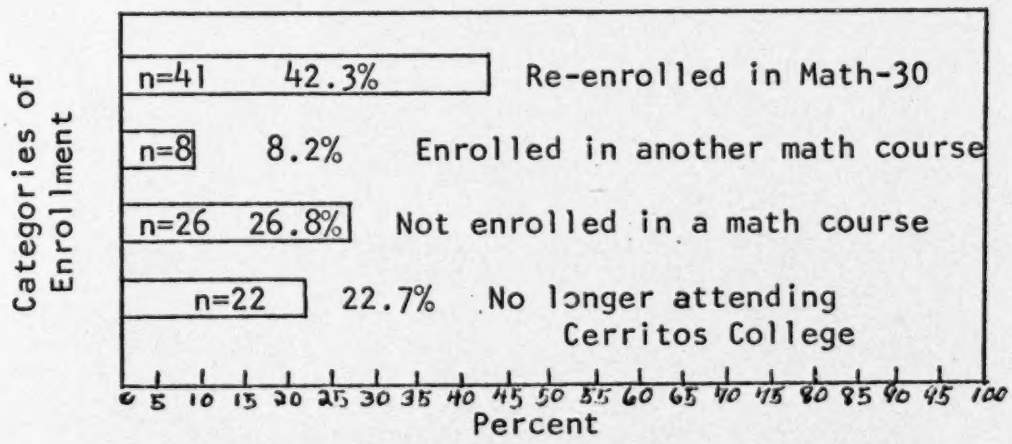
n=41 42.3% Re-enrolled in Math-30
n=8 8.2% Enrolled in another math course
n=26 26.8% Not enrolled in a math course
n=22 22.7% No longer attending Cerritos College
Categories of Enrollment
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent

Fig. 6. Summary of follow-up results ("L.M.C." students who received a "Withdrawal" grade): frequencies and proportions across categories of enrollment.

Lecture Classes

In reference to the 76 students who earned a grade of W in a "L" math course sampled: 11 or 14.5% re-enrolled in a "L" Math-30 course; 5 or 6.6% re-enrolled in a "L.M.C." Math-30 course; 3 or 3.9% enrolled in Math-23; one or 1.3% in Math-50. Twenty-five (25) or 32.9% were not enrolled in a math course and 31 or 40.8% were no longer attending Cerritos College.

Concerning the 4 students who received a grade of UW: one was re-enrolled in a "L" Math-30 course; two were not enrolled in a math course, and one was no longer attending Cerritos College. See Table 4.

Table 4

Follow-Up Results of those "L" Students Who Received a W or UW Grade: Frequencies and Proportions Across Categories of Enrollment.

W's			UW's		
Math 30 "L"	11	14.5%	Math 30 "L"	1	25.0%
Math 30 "L.M.C."	5	6.6%			
Math 23	3	3.9%	Not enrolled in math course	2	50.0%
Math 50	1	1.3%			
Not enrolled in math course	25	32.9%	Not attending Cerritos	1	25.0%
Not attending Cerritos	31	40.8%			
		100.0%			100.0%

Combining the data of the 80 students who had earned a W or UW in a "L" math course: 12 or 15% re-enrolled in a "L" Math-30 course; 5 or 6.2% re-enrolled in a "L.M.C." Math-30 course; 3 or 3.8% enrolled in

Math-23; 1 or 1.2% in Math-50. Twenty-seven (27) or 33.8% were not enrolled in a math course, and 32 or 40% were no longer attending Cerritos College. See Figure 7.

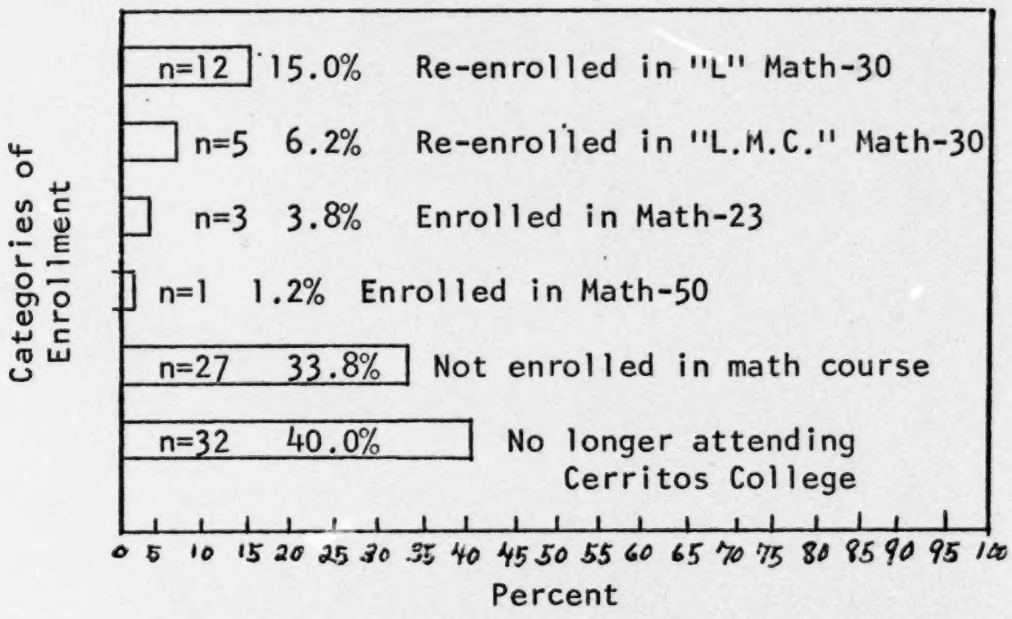
n=12 15.0% Re-enrolled in "L" Math-30
n=5 6.2% Re-enrolled in "L.M.C." Math-30
n=3 3.8% Enrolled in Math-23
n=1 1.2% Enrolled in Math-50
n=27 33.8% Not enrolled in math course
n=32 40.0% No longer attending Cerritos College
Categories of Enrollment
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent

Fig. 7. Follow-Up results of "L" students (W's and UW's combined): frequencies and proportions across categories of enrollment.

In summary, 30 or 21.2% of the 80 students had re-enrolled in a Math-30 course; 4 or 5% were enrolled in another math course; 27 or 33.8% were not enrolled in a math course, and 32 or 40% were no longer attending Cerritos College. See Figure 8.

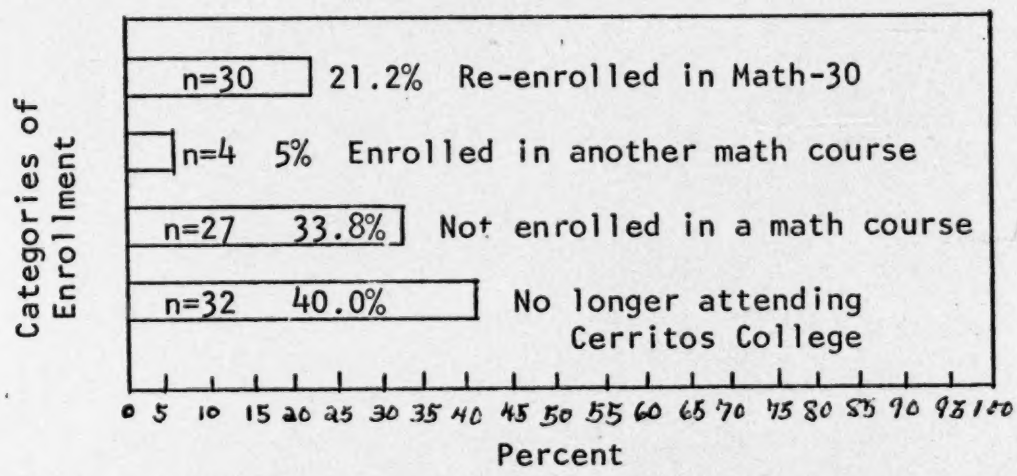
n=30 21.2% Re-enrolled in Math-30
n=4 5% Enrolled in another math course
n=27 33.8% Not enrolled in a math course
n=32 40.0% No longer attending Cerritos College
Categories of Enrollment
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
Percent

Fig. 8. Summary of follow-up results ("L" students who received a "Withdrawal" grade): frequencies and proportions across categories of enrollment.

In addition, Figure 9 presents a graphic comparison between "L.M.C." and "L" students in reference to the summary of follow-up results.

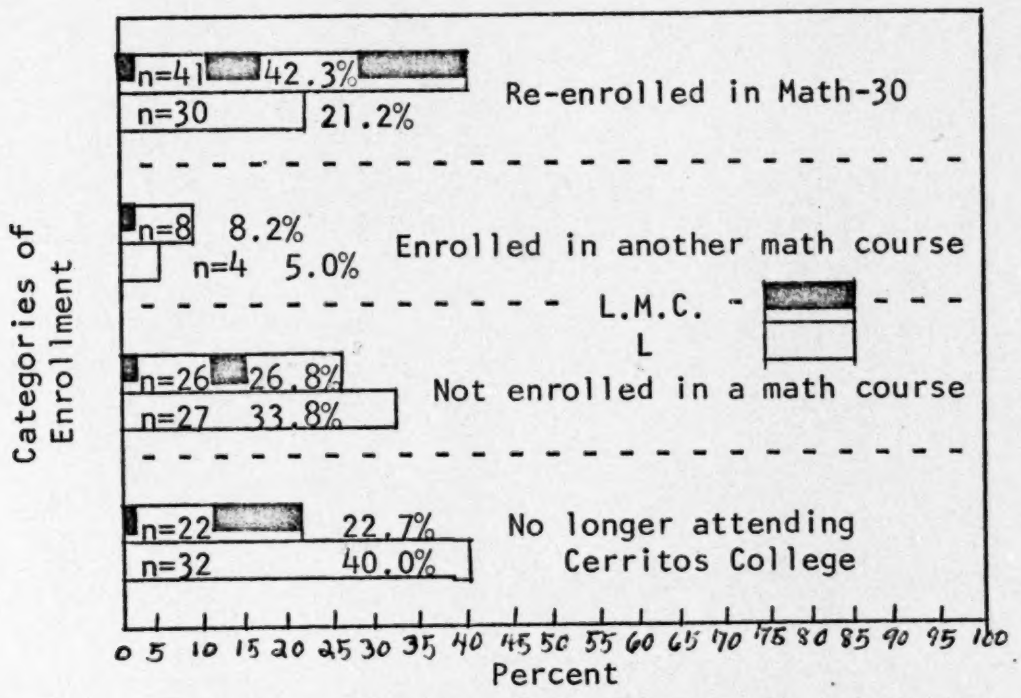

Fig. 9. Comparison between "L.M.C." and "L" students - a summary of follow-up results ("L.M.C." and "L" students who received a "Withdrawal" grade): frequencies and proportions across categories of enrollment.

Summary and Conclusions

In the Fall semester 1971 the five "L.M.C." Math-30 courses had a total enrollment of 188 students while the five "L" Math-30 courses sampled for comparison had a total enrollment of 203 students.

Analysis of SCAT-Q Placement Test scores revealed that there was no significant difference in "mathematical aptitude", as measured by the SCAT-Q Placement Test, between "L.M.C." and "L" Math-30 students.

In the Spring semester 1971, 41 of the 97 "L.M.C." students who had earned a "Withdrawal" grade re-enrolled in a Math-30 course and eight enrolled in another math course. In reference to the "L" Math-30 classes sampled, 30 of the 80 "L" students who had earned a "Withdrawal" grade re-enrolled in a Math-30 course and 4 enrolled in another math course.

Therefore, 49 or 50.5% of the 97 "L.M.C." students who had earned a "Withdrawal" grade in the previous semester re-enrolled in a math course for the subsequent semester, while 21 or 26.2% of the 80 "L" students who had received a "Withdrawal" grade re-enrolled in a math course for the spring semester.

Furthermore, of the 97 "L.M.C." students who earned a "Withdrawal" grade, 48 or 25.5% of the 188 originally enrolled did not re-enroll in a math course. Regarding the 80 "L" students who received a "Withdrawal" grade, 59 or 29.1% of the 203 originally enrolled did not re-enroll in a math course.

Thus, if one uses the criterion of "did not re-enroll in a math course" as a measure of retention for those students who received a "Withdrawal" grade in the previous semesters Math-30 course, one observes a small percentage difference (3.6%) in favor of the "L.M.C." math courses. However, this difference was not statistically significant* therefore one should not make the inference that "L.M.C." Math-30 methods result in higher retention rates since a small percentage difference such as has been observed in the present study between the "L.M.C." and "L" Math-30 courses is most likely a function of sampling error. Therefore, the most tenable inference is that there is, in most probability, no difference in retention rates between "L.M.C." and "L" Math-30. Table 5 presents a graphic summary comparison between "L.M.C." and "L" Math-30 students.

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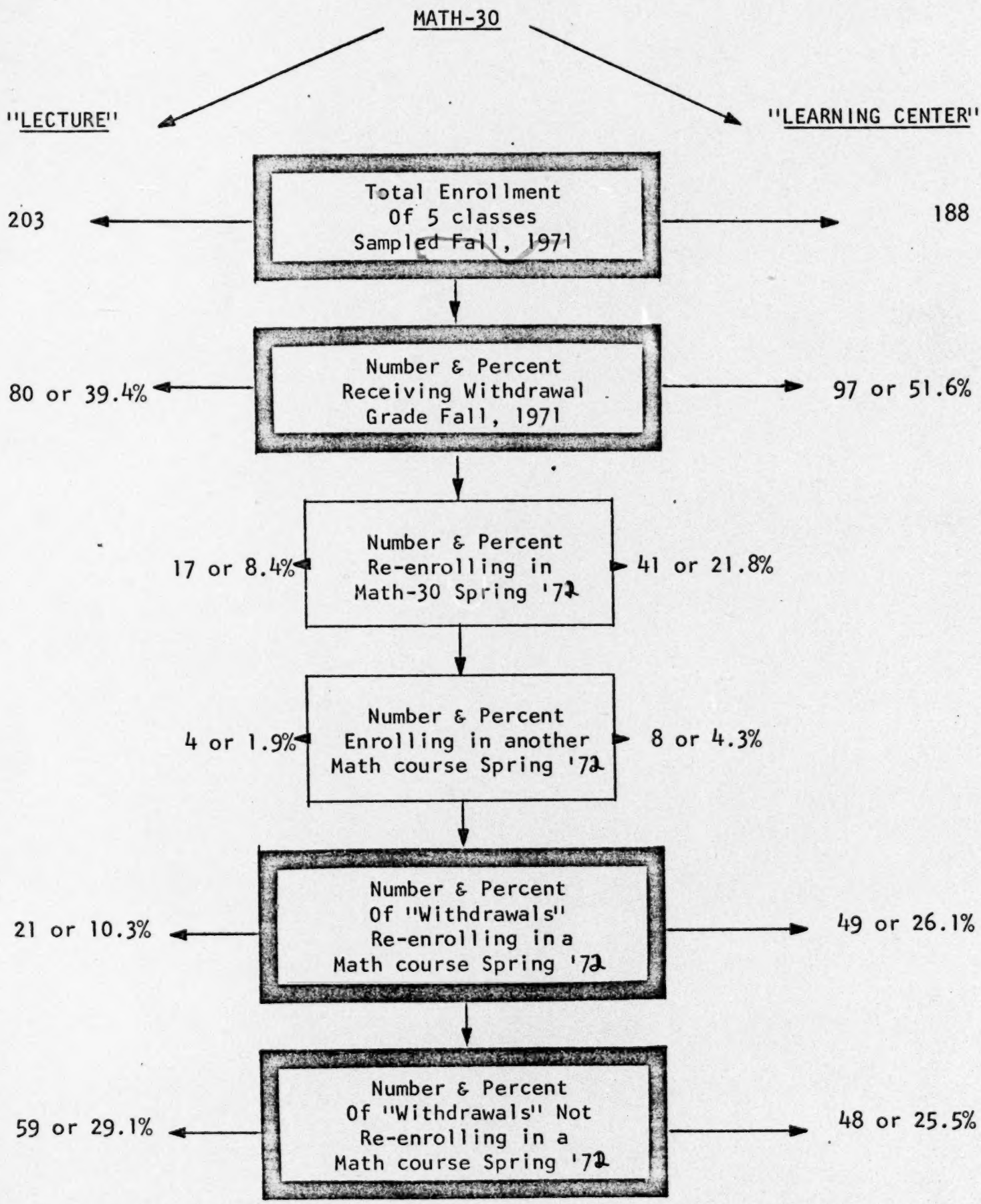
* Fisher's Test of a difference between uncorrelated proportions was employed (.05 level of confidence).

Table 5

Summary Comparison of Retention Between
"L.M.C." and "L" Math-30 Students.



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Concerning grade distribution, a comparison of academic achievement (gradés A through E) across "L.M.C." and "L" Math-30 courses revealed that relative to original enrollment totals, 7.9% more of the "L.M.C." students earned A's. Concerning the percentage of students earning the grade of B there was no difference between the "L.M.C." and "L" math courses. Analysis of C grades revealed that 14.4% more of the "L" students earned C's. Pertaining to the grades of D, F, and E, 5.7% more of the "L" students received a grade in this category.

Thus if one uses total enrollment figures as the base from which grade distribution percentages are computed it appears that: (1) a higher proportion of the "L.M.C." students earned A's; (2) there was no significant difference in the proportions of B's and; (3) a higher proportion of the "L" students earned C's.

Furthermore, if one operationally defines "successful achievement" as having earned a grade of A, B, or C, and "unsuccessful achievement" as having earned a grade of D or F and, if the total enrollment figure is again used as a divisor in the computation of the percentage of "successful" versus "unsuccessful achievement" one observes that 6.6%* more "L" students earned a "successful grade" than did the "L.M.C." students.

On the other hand, if the computation of "successful" and "unsuccessful" achievement is based on the total number of "L.M.C." or "L" students that earned a grade of A, B, C, D, or F, then one observes that 82 or 94.2% of the 87 "L.M.C." students attained "successful" achievement compared to 102 or 83.6% of the 122 "L" students. Therefore, of those students receiving a grade of A through F, 10.6% more of the "L.M.C." students attained successful achievement.**

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* This difference was <u>not</u> significant at the .05 level of confidence.
** This difference was significant at the .05 level of confidence.

In conclusion, if one is of the opinion that "did not re-enroll" is a valid measure of retention, then it appears that the distribution of grades A through F should be computed using a divisor that does not include the "Withdrawal" category grades. This would be especially critical in the comparison of courses in which a difference in re-enrollment was observed between the courses being compared.

Future research possibilities include, but are not limited to the following: (1) a comparative analysis of algebra skills between "L.M.C." and "L" Math-30 students as measured by a standardized algebra test administered after course completion; (2) a comparative study between the "L.M.C." and "L" Math-30 students who "re-enrolled" (Spring, 1972) as measured by retention rate and "academic achievement" and; (3) a comparative analysis between "L.M.C." and "L" Math-30 students relative to "academic achievement" and retention in the next level math course.